Will Congestion Pricing Help Curb Traffic Jams?

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With traffic volume increasing in India's megacities, the discourse over congestion has evolved from looking at it as a by-product of urbanisation to exploring various measures to manage or control the flow during peak hours. We argue that the time has come for congestion taxes to be tested on a pilot basis in major Indian megacities, and for it to succeed, it is imperative that public transport infrastructure be scaled up.

With the influx of population and increased usage of personal vehicles, cities in India, especially megacities (cities with a population of more than 5 million), have been seeing traffic jams and congestion on a daily basis. This has led to commuters taking to various forms of social media to express their helplessness and angst against the snarling jams that have become the haphazard feature of urbanisation in India. In response, local governments have been attempting to scale up road infrastructure and provide more road space for commuting vehicles. However, the continued presence of long and chaotic traffic jams shows that such measures have yielded little. Some cities like Hyderabad have attempted route diversions to reduce the jams, especially in peak hours, but to no avail.

In September 2023, Bengaluru reported a massive jam in its information technology corridor for many hours following a long holiday weekend. This incident raised several questions about the skewed usage of private transport in our cities, despite alternative modes of public transit like the metro rail in place. Post this, media reports (*Economic Times* 2023) suggested that a London-style congestion tax was being mooted to reduce the influx of personal vehicles, primarily focusing on cars.

What Is 'Congestion Pricing'?

Touted as a panacea for solving traffic congestion, a congestion tax or congestion pricing is effectively a toll "within" the city premises and indirectly penalises commuters for using private vehicles (including two-wheelers and four-wheelers) to gain access to the central business district (CBD). The toll aims to reduce traffic in areas with intense gridlock by creating an economic barrier to entry. In effect, it attempts to recover (in monetary terms) the additional cost imposed on the road (by taking up some road space) by the commuter through their decision to use a personal vehicle for their daily commute. Congestion costs generated by the user's decisions to opt for such a mode of commute thus create a negative externality where the marginal social costs of congestion are higher than the marginal private cost, necessitating timely intervention from the state to correct it through fiscal measures such as levy of a tax. Throwing more light on the idea, Hewitt (1964) noted that congestion taxes would be justified in areas where there is excess capacity in the supply of a competing service.

The basis for a congestion tax comes from the assumption that the length of urban roads is fixed, implying limited carrying capacity for an uncongested commute. Bruckner (2011) posits that there exists an inverse relation between the number of vehicles on the road (represented by T) and commute cost (g), which is the essence of the demand curve for city roads. The commute is assumed to be uncongested till point α, and the cost of the commute is measured as a sum of the monetary cost of the commute (m) and the time cost.

In Figure 1 (p 19), we find that upon the entry of another vehicle beyond level α (level of uncongested commute), the cost of commute goes up on two counts: additional road space needed to make way for the extra vehicle and the slowing down of the time for commute, thus creating inefficiency in the road network by paving the way for a negative externality.

A mathematical exposition of the same is presented below:

$$\text{Commute Cost } (g) = m + w^* (D/s) \quad \ldots (1)$$

$$\text{Aggregate commute cost} = T^* g(T) \ldots (2)$$

Wage (out of which expenditure for travel is made and is used to measure hourly commute) is denoted by w, while time is a ratio of the distance travelled (measured as D) per unit speed (measured as s). It is to be noted that as congestion occurs after α, speed reduces on the roads, thereby increasing the time to reach the endpoint. The objective of a rational commuter is to minimise the commute cost to the extent possible. As observed in the graph, post α, there is

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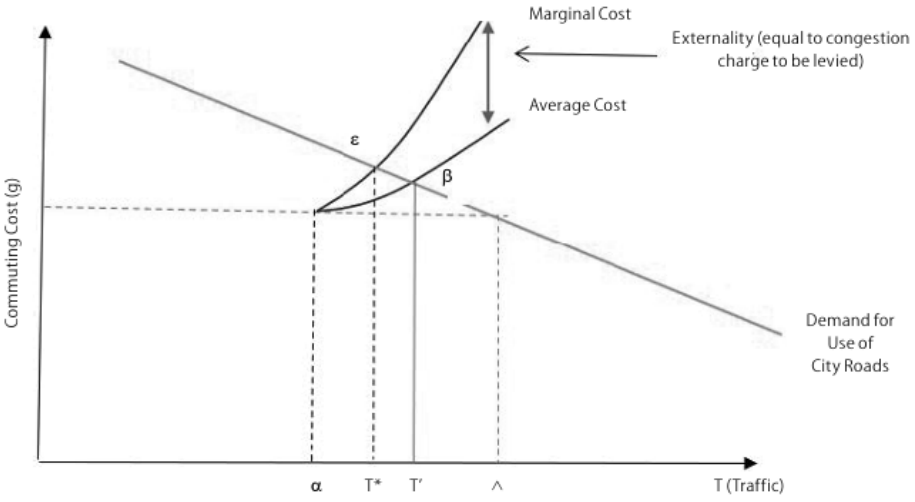
Figure 1: The Economics behind Congestion Pricing



Source: Breuckner (2011).

inefficiency created with higher marginal costs and increasing average cost. The aggregate commute cost of all vehicles plying on the urban road is considered as $T * g(T)$ (defined as the product of the commute cost of each vehicle and the total number of vehicles plying on the road).

Differentiating equation (2) with respect to T yields,

$$\frac{\partial (g)}{\partial T} = g(T) + T \,.\, g'(T) \qquad \ldots (3)$$

The marginal cost of commuting is, therefore, a sum of the average commute cost ($g(T)$) and an additional component, which is the cost of the externality created due to congestion. The theoretical economic framework suggests that the additional cost incurred is equivalent to the damages incurred in terms of congestion and, thus, should be the amount levied in the form of a congestion charge. This is given by the vertical distance between the average cost curve and the marginal cost curve in Figure 1; had there been no congestion, and the assumption of a "fixed" freeway or an urban road was relaxed to enable an infinite capacity of vehicles, the marginal cost curve would have coincided with the average cost curve rendering the externality damage to zero.

We thus find that upon levy of a congestion charge in lieu of an additional number of vehicles being allowed to ply on the road, the social optimum is attained at a level where there is a relatively lesser number of vehicles plying on the urban road at T^* ($T^* << T'$). The questions that confront policymakers regarding such a policy are many. One is around the issue of a uniform congestion price across the city's CBD. Others argue that having multiple prices subject to the extent of congestion that occurs is a more feasible alternative. The issues extend to attempting the estimation of such a cost curve or even demand for roads vis-à-vis the estimated commute costs in order to first arrive at an optimum congestion charge.

Global Examples

The idea, however, is not new. Having been implemented in major cities such as Singapore, Hong Kong, London, and Stockholm, it has succeeded in some and failed in others. Singapore was the first city to implement it through what was known as the Area Licensing Scheme in 1975, with a stated aim to reduce the peak hour traffic by at least 25%. An additional licence (available on a daily or a monthly basis) had to be purchased by the motorists to use their personal vehicles in the restricted zone of the CBD area during the peak hours. In the early stages of the scheme, the congestion charge was fixed at 3 Singapore dollars and was levied initially during the morning hours in an area of 2 square miles of the CBD with certain exemptions. The 1975 scheme has graduated into an Electronic Road Pricing programme today, with vehicles being monitored with live cameras and electronic records of the tolls being made, with variation in amounts of the congestion charges as per the area, and hefty fines in place to discourage violations. It is pertinent to note that the expansion of the policy was accompanied by increased spending on public transit infrastructure, ensuring a modal shift through increased patronage of buses and the mass rapid transit rail. Bhat et al (2008) showed that the pricing pattern produced a reduction in traffic by more than 30% in the 30 years that it was in vogue. The scheme also generated revenue over and beyond the operating cost (by a factor of 11), as per the authors, indicating that the revenue generated could be used to channel back into the maintenance of the public transportation system (as done in London and Stockholm).

In London, congestion pricing was implemented in 2003. It covered an area of 8 square miles of central London, which later expanded to an additional area of 8 square miles, with a weekday fee of £5 for entry and exit in the said area. The implementing authority shows that the charge has gone up to £15 as of date, with exemptions for buses, registered taxis, national health service vehicles, motorbikes, and emergency services vehicles, while others have various levels of discounts.

A Case for Indian Cities

The recent vehicular composition in major cities points to a skewed pattern wherein non-transport vehicles (cars, mopeds, two-wheelers, omnibuses for private use, etc) dominate the roads among major cities. As shown in Table 1, the highest number of non-transport vehicles were registered in the National Capital Region (NCR) of New Delhi, followed by Bengaluru, Chennai, Ahmedabad,

Table 1: Number of Registered Transport and Non-transport Vehicles, 2020

	Transport	Non-transport	Total
Delhi	6,21,219	1,12,71,658	1,18,92,877
Kolkata	1,24,868	8,99,209	10,24,077
Chennai	5,70,304	57,81,425	63,51,729
Bengaluru	11,41,712	84,96,650	96,38,362
Mumbai	4,46,659	34,29,506	38,76,165
Hyderabad	2,50,988	29,91,821	32,42,809
Pune	2,23,639	29,75,190	31,98,829
Kochi	99,459	8,57,102	9,56,561
Jaipur	2,52,443	29,15,900	31,68,343
Lucknow	1,23,599	24,94,231	26,17,830
Ahmedabad	4,50,099	41,21,094	45,71,193

Source: *Road Transport Year Book 2020*, Ministry of Road Transport and Highways, Government of India.

Mumbai, and Hyderabad. Some other major cities with similar figures include Pune, Jaipur, and Lucknow. TomTom Traffic's Annual Traffic Index report of 2023 (which considered four cities in India) ranked Bengaluru the sixth most congested city in the world, followed by Pune (7), New Delhi (44), and Mumbai (54).

To draw more light on the congestion problem and make a pertinent case for congestion pricing and the scaling up of public transit systems, we refer to data sourced from Numbeo, a Serbian database. One of the metrics used is the time index (Table 2). Measured in minutes, it estimates the average time taken to cover two points in a city. However, the index does have certain limitations. First, time taken can vary according to a city's topography, and second, it is not fully explicit which two endpoints are accounted for in the computation of the metric.

The data shows that the average time clocked was the highest in Kolkata at 60.05 minutes, followed by Delhi (57.4), Mumbai (54.9), and Bengaluru (53). Hyderabad recorded the least time taken relatively to cover two ends of the city at 42.55 minutes. This shows that the commute time is a minimum of 40 minutes, indicating the extent to which traffic externality can occur due to increased congestion (due to increased use of private vehicles and inadequate public transport system).

The inefficiency index (which measures the extent of inefficiency generated due to the number of private vehicles on the road) shows that Indian cities have a very high degree of inefficiency, with the highest being recorded in the Delhi NCR and the least in Hyderabad (Table 3). A higher index value indicates higher inefficiency, implying that more vehicles are plying on the roads (with constrained capacity). On a year-on-year basis, we have found that the inefficiency score has increased in Pune, Bengaluru, and Hyderabad while remaining stagnant in Delhi and Mumbai. While Chennai and Kolkata's scores have reduced over the years, it suggests that traffic inefficiency is a problem that needs to be addressed seriously by the concerned authorities in most cities.

Table 2: Time Index (Measured in Minutes) (as on 26 April 2024)

Cities	2021	2022	2023	2024	Average
Delhi	57.2	57.4	57.4	57.7	57.425
Mumbai	55	54.6	54.9	55.3	54.95
Pune	44.1	43.5	43.7	45.5	44.2
Bengaluru	52.9	52.6	52.7	54.1	53.075
Hyderabad	42.7	42.8	42.1	42.6	42.55
Chennai	48	47.5	47.3	46.8	47.4
Kolkata	60.6	60.4	59.8	59.4	60.05

Source: www.numbeo.com.

Table 3: Inefficiency Index for Indian Cities

Cities	2021	2022	2023	2024
Delhi	315.2	315.5	314.3	315.2
Mumbai	277.2	273	273.9	275.7
Pune	203.8	200.5	202.7	248.4
Bengaluru	279.8	278.6	277.8	296.5
Hyderabad	204.5	205.3	203.6	209.6
Chennai	239.4	236.5	234.3	230.9
Kolkata	299.5	294.5	290.5	286.2

Source: www.numbeo.com.

It is in this context that a tool-like congestion pricing has to be looked at. In the Indian urban management dicourse, the idea has been toyed with for many years now, with a formal recommendation being made by the Ministry of Housing and Urban Affairs to state governments back in 2013 to undertake studies to explore the feasibility of congestion pricing in Indian cities. However, alternative approaches have been undertaken through the National Clean Air Programme, with city-specific Clean Air Action Plans being rolled out along with the gradual upgrading of transit infrastructure through the Smart Cities Mission and Faster Adoption and Manufacturing of Electric Vehicles (FAME). However, these do not target the root cause of congestion which lies in the widespread use of personal vehicles with limited road space in our cities, making a tool like congestion pricing important.

Scaling Public Transit Systems

As seen in London, the implementation of congestion charge zones holds lessons for Indian cities. Given the limited public transport infrastructure, implementing a one-off congestion pricing programme would reverse the purpose and would create heavy stress on the alternative modes. A pilot can be rolled out in areas of relatively lower congestion in parts of the CBD (and other choke points), introducing a pricing mechanism. Based on the patterns observed, the programme can be scaled up to include major central zones or zones with high-density vehicular traffic. However, a necessary condition that must be enforced even during a pilot study is to ensure that adequate public transport alternatives are made available to cater to the expected increase in demand. Public transport arrangements that can accommodate the number of commuters equivalent to the sacrifice ratio of personal vehicle users (the number of people currently using personal vehicles and are likely to reduce their usage and opt for alternatives such as carpooling or public transport) should be made. What also needs to be considered is how the price has to be determined and on what basis (polluters/congestion creator's pay principle or a charge equivalent to the amount that is enough to discourage private transit), in addition to demarcating congestion zones based on high vehicular density and levels of pollution. Additional issues that need to be looked at include the type of exemptions that can be provided and how the revenue generated by the imposition of such a charge would be used.

Congestion charging is a powerful instrument for managing traffic congestion. However, the scheme will not succeed unless supplementary measures are taken. This calls for a robust system of transit financing, transit governance, and integrated transport land use planning. Many countries have dedicated funding for public transit systems. In the United States, out of the total motor fuel tax collected, 8% is earmarked for highways and 15% for public transit, called the mass transit account. Similarly, transit authorities in France have access to dedicated transport tax. India may consider dedicated funds for public transit, including national and state fuel tax, motor vehicle registration tax, truck weight fee, betterment levies, other land-based taxes, and parking charges. This calls for dedicated agencies like the Unified Metropolitan Transportation Authority for effective transit governance. They need to be empowered and operationalised with dedicated funds and expertise. The crux of the congestion problem emanates from the neglect of transport-land use integration, transit-oriented

development, transportation systems management, and transport demand management. These may include radial, arterial, and ring roads linked to transit-oriented development and last-mile connectivity so that no one walks to a transit station for more than 15 minutes. Transit subsidies will also be required to restrict private transport use and promote car-pooling. Congestion pricing also requires the necessary political will and cooperative federalism with central-state-local-private-people partnerships.

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